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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Marina E. Kondakova, et al

ORGANIC
ELECTROLUMINESCENT DEVICES
WITH ADDITIVE

Serial No. US 10/729,737

Filed 05 December 2003

Commissioner for Patents
P.O. Box 1450
Alexandria, VA. 22313-1450

Sir:

Group Art Unit: 1774

Examiner: Dawn L. Garrett

I hereby certify that this correspondence is being deposited today with the United States Postal Service as first class mail in an envelope addressed to Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Deidra L. Mack

Deidra L. Mack

January 16, 2007

Date

**SECOND DECLARATION OF MARINA E. KONDAKOVA
UNDER 37 CFR 1.132**

The undersigned, Marina E. Kondakova, declares that:

She has received the degree of M.Sc., Colloid and Surface Chemistry from St. Petersburg University, St. Petersburg, Russia in 1987 and Ph.D., Physical Chemistry from St. Petersburg Technological University of Plant Polymers, St. Petersburg, Russia in 1993;

Since 1993 she has been employed as a research scientist with the Institute for Molecular Science, Okazaki Japan, then with the Research Institute of the Pulp and Paper Industry, St. Petersburg, Russia, and, since 2002, with the Display and Components OLED Materials R&D Group of Eastman Kodak Company;

She is an inventor in the above-captioned patent application;

She has reviewed the outstanding Office Action and any applicable cited references;

I. Following receipt of the final rejection, it was discovered that the Triplet Energy Value for MTDATA in the specification (page 12/ ln 16), as quoted from the open literature, was in error.

Subject to my direction and control, we have now measured the triplet energy for MTDATA by the experimental method described in the specification (par. 0042). Table 2 shows the result along with triplet energies for NPB and Ir(ppy)₃ that have been measured previously in our laboratories. These data show that the triplet energy of MTDATA lies above that of Ir(ppy)₃, whereas the triplet energy of NPB lies below that of Ir(ppy)₃. The new value for MTDATA disagrees with a value that we had extracted from literature data (our par. 0042). The disagreement has been resolved in the following way. There was a discrepancy between the legend and the caption for the figure containing the literature data. We believed that the caption was correct and the legend was incorrect; and on that basis we misidentified the phosphorescence spectrum of MTDATA. We now realize that the legend was correct and the caption was incorrect, and with this realization, our spectrum agrees adequately with the literature spectrum for MTDATA. The literature spectrum, now correctly identified, gives a triplet energy of 2.64 eV, in good agreement with our own value. Thus, it is now clear that the triplet energy of MTDATA is above that of Ir(ppy)₃, and that MTDATA is an example of an efficiency-enhancing material within the scope of Claim 1.

TABLE 2: TRIPLET ENERGIES

Compound	Function	Triplet Energy (eV)
MTDATA	Hole-transport material	2.67
NPB	Hole-transport material	2.41
Ir(ppy) ₃	Phosphorescent Dopant	2.54

II. Further, under her direction and control, the following examples were prepared and conducted with the results as described in the following:

These examples demonstrate the importance of the selection criterion that the efficiency-enhancing material must have a higher triplet energy than that of the phosphorescent dopant.

Experimental examples:

A comparative EL Device 6 not satisfying the requirements of the invention was constructed in the following manner:

1. A glass substrate, coated with an approximately 85 nm layer of indium-tin oxide (ITO) as the anode, was sequentially ultrasonicated in a commercial detergent, rinsed in deionized water, degreased in toluene vapor, and exposed to an oxygen plasma for about 1 min.
2. Over the ITO, a 1 nm fluorocarbon (CF_x) hole-injecting layer (HIL) was deposited by plasma-assisted deposition of CHF_3 as described in US6208075.
3. Next, a hole-transporting layer (HTL) of *N,N'*-di-1-naphthyl-*N,N'*-diphenyl-4,4'-diaminobiphenyl (NPB) was vacuum deposited to a thickness of 75 nm.
4. A 35 nm light-emitting layer (LEL) consisted of mixture of 4,4'-*N,N'*-dicarbazole-biphenyl (CBP) as a host, tris(2-phenylpyridinato) iridium (III) [i.e., $\text{Ir}(\text{ppy})_3$] at 6 wt. % as a phosphorescent guest material, and NPB at 3 wt. % as an efficiency-enhancing material (EEM) was then deposited onto the hole-transporting layer.
5. A hole-blocking layer (HBL) of bis(2-methyl-quinolinolato)(4-phenylphenolato) aluminum(III) (BAIq) having a thickness of 10 nm was then evaporated over the LEL.
6. Next, a 40 nm electron-transporting layer (ETL) of tris(8-quinolinolato) aluminum (III) (Alq) was then deposited onto the hole-blocking layer.
7. On top of the Alq layer was deposited a 220 nm cathode formed of a 10:1 volume ratio of Mg and Ag.

The above sequence completed the deposition of the EL device. The device, together with a desiccant, was then hermetically packaged in a dry glove box for protection against ambient environment.

A comparative Device 7 not satisfying the requirements of the invention was fabricated in an identical manner to Device 6 except that 10 wt.% NPB was used as efficiency-enhancing material in the LEL.

An inventive Device 4 and a comparative Device 5 were fabricated again (repeated) in an identical manner as described in US 2005/0123797, par.0208.

The devices thus formed were tested for efficiency and color at an operating current density of 6 mA/cm². The results, including 1931 CIE (Commission Internationale de l'Éclairage) coordinates, CIE_x and CIE_y, are reported in Table 3.

TABLE 3: EVALUATION RESULTS FOR EL DEVICES

Device	EEM	Wt.% of EEM	Luminous yield, cd/A	Power efficiency, lm/W	CIE _x	CIE _y	Type
6	NPB	3	14.0	4.5	0.298	0.620	comparison
7	NPB	10	4.3	1.5	0.283	0.574	comparison
4	MTDATA	10	28.4	8.5	0.296	0.624	invention
5	none	0	23.5	7.2	0.303	0.626	comparison

As can be seen from Table 3, inventive Device 4 containing 4,4',4''-tris(*N*-3-methylphenyl-*N*-phenyl-amino)triphenylamine (MTDATA) as efficiency-enhancing material demonstrates the highest luminous yield and power efficiency. The comparison Devices 6 and 7 containing NPB, which fall outside the scope of Claim 1, are less efficient than the comparison Device 5 that contains no EEM.

The foregoing data show that addition of a lower-triplet-energy material into the LEL reduces the luminous yield and power efficiency, whereas addition of a higher-triplet-energy material increases the luminous yield and power efficiency. Contrary to the teaching of Seo, these data demonstrate that hole-transporting materials with lower and higher triplet energies are completely inequivalent as additives to the LEL.

All statements made herein of my knowledge are true, and all statements made on information and belief are believed to be true. These statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 16 day of January, 2007

M. Kondakova
Marina E. Kondakova